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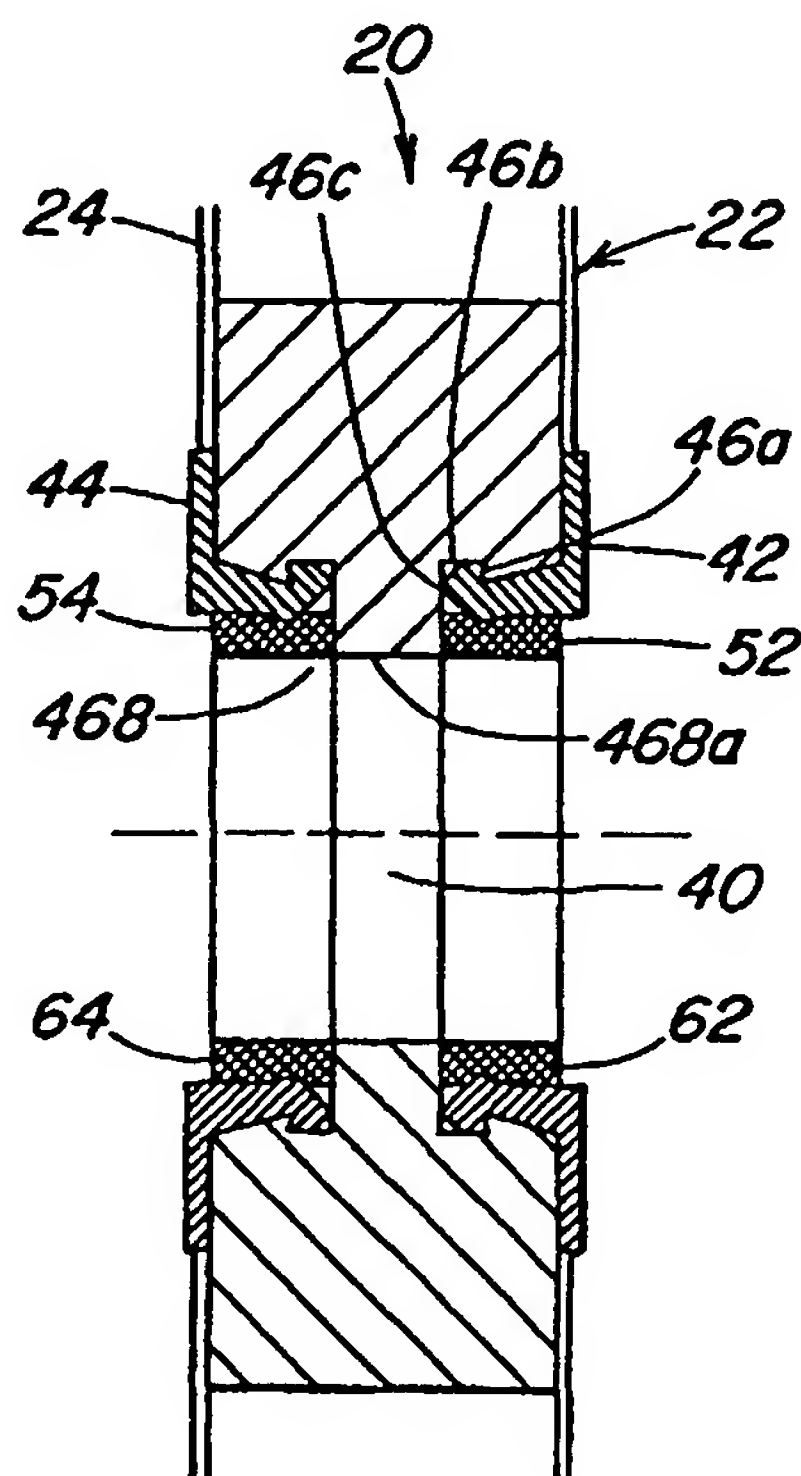
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(54) Title: METHOD OF ASSEMBLING A FILTER PLATE



(57) Abstract: A method is provided for fixedly joining a cloth (22), a cloth-like fabric (22, 24) or a synthetic mesh (22, 24) to a filter plate (20) using a flanged cloth connector ring (42, 44). The flanged cloth connector ring (42, 44) is attached to the filter cloth (22, 24) around the feed port (52, 54) of the cloth and inserted into a receiving channel (46, 47) in the filter plate (20). A locking ring (62, 64) may be inserted into the channel (46, 47) adjacent to the connector ring (42, 44) to retain the connector ring (42, 44) and attached filter cloth (22, 34) in plate (20). Filter cloths (22, 24) may be individually and independently attached to each side of a filter plate (20) using a cloth connector ring 42, 44).

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METHOD OF ASSEMBLING A FILTER PLATE

RELATED APPLICATIONS

The present application claims priority to U.S. Provisional Patent Application
5 Serial Number 60/414718, entitled "Method of Assembling a Filter Plate", filed
September 30, 2002, the contents of which are herein incorporated by reference.

FIELD OF THE INVENTION

The present invention relates to a filter plate in a filter press for separating solids
10 and liquids. More particularly, the present invention relates to a system and method for
attaching a filter media to a filter plate.

BACKGROUND OF THE INVENTION

A filter press is an economic and efficient liquid/solid separation device
15 commonly utilized in the clay, chemical, or mining industries. Filter presses generally
employ a plurality of filter plates, each filter plate having large areas of a textile material
to form a filtering screen. The textile material is typically attached to a cloth, rubber or
plastic tubular hub. The tubular hub allows the material to be filtered to pass through
successive filtering chambers in the press. The tubular hub must be securely attached to
20 the filtering material to prevent leakage, and is usually constructed of a textile tube or a
thermoplastic or rubber material.

In the current state of the art, filter cloth is generally installed on the filter plates
by rolling up one side of a duplex filter cloth, which is joined at a feed hole with the
25 tubular hub, and then pushing the rolled up filter cloth through the feed hole of the filter
plate. After passing the rolled cloth through the feed hole, the filter cloth is then
unrolled. The filter plate thus has a layer of filter cloth on either side thereof, and the
two filter cloth layers are fastened together on the filter plate. Slurry is pumped into the
filter press and fills each cavity within the stack of filter plates. Solids remain in the
30 chambers and filtrate passes through the cloth, exiting the filter plate.

Conventional methods for joining the filtering material to the tubular hub include sewing the two filter cloth layers together. This approach is labor intensive and thus expensive. Moreover, the sewing tends to create weaknesses in the joint due to the stitch holes. Stitching can also be difficult due to the thickness of the filter cloth and the tubular hub. Other methods include adhesive and bonding agents to secure the filtering cloth to the tubular hub, but these techniques are time consuming since the adhesive must set to form the bond, and is not consistently reliable. Welding requires a split clamping collar positioned between the flanges of the feed neck to transmit force to the weld from a clamping cylinder.

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U. S. Patent 4,765,859 describes a method of joining filter cloth to a rubber tubular hub for use as a filter screen, which is installed on a filtering plate in a filtering press. The hub consists of a cylindrical tube that includes two annular flanges protruding radially outward from the circumference of the tube at each end. The tubular hub is fabricated from a rubber material that is collapsible. A filtering screen is then constructed by joining two filter cloths to the hub at each end of the tube. One filter cloth is joined to the hub at the inside surface of one flange, while the other filter cloth is joined to the inside surface of the other flange. The filter cloth and hub are bonded together by induction heating to form a seal to prevent leakage of the filtered material.

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U.S. Patent Number 5,958,173, the contents of which are herein incorporated by reference, describes a method of fabricating a filter screen for a filter press by attaching a filter cloth to a tubular hub using induction heating.

The methods in the prior art of attaching a filter cloth to a filter plate pose a number of disadvantages. The prior methods of installing filter cloth are difficult and time consuming, particularly for larger filters (up to 2 meters by 2 meters square). The large cloth requires a person on each side of the filter plate: one person to push the filter cloth through the hole, and the other person to receive the filter cloth. Large presses are usually re-clothed without removing plates, requiring operators to get between the plates physically, sometimes on platforms above conveyors or high above the ground level, a procedure that can be dangerous. The removal of filter plates in order to replace the

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filter cloths causes significant losses in productivity, as the filter press cannot be used during the replacement process.

Furthermore, the duplex-type of filter cloths used in the prior art can be
5 expensive, as both layers of a duplex filter cloth must be removed and replaced when a hole forms in only one of the layers. The process of assembling the duplex filter cloths on a flanged tube for attachment to a filter plate is also complex and unwieldy.

It is thus desirable to find a new method for securely joining a filtering material
10 such as a cloth fabric or synthetic material, as commonly used in filtering applications, to a filter plate.

SUMMARY OF THE INVENTION

The present invention addresses the need for an efficient and effective method for
15 attaching a filter cloth to a filter plate installed in a filter press. In an illustrative embodiment of the present invention, a flanged cloth connector ring is fastened about the inner edge of a central feed port in a filter cloth to attach the filter cloth to a filter plate. The connector ring may include a collar portion and a flanged tab portion extending substantially perpendicular to the collar portion. The filter cloth is attached to the
20 connector ring at the collar portion. The flanged tab portion includes a tab clip on an outer surface thereof configured to interface with a slot or bore in the filter plate body, thereby connecting the filter cloth to a first side of the filter plate. A locking ring or a distribution ring may be used to retain the connector ring and lock the tab clip into the filter plate body. Serrations may be provided on an inner surface of the tab portion of
25 the connector ring to hold the lock ring or distribution ring in place by friction fit.

An assembled filter plate may comprise a pair of filter cloths, which are individually attached to each side of the plate using the cloth connector ring and a locking or distribution ring.

According to one aspect of the invention, a connector for attaching a filter cloth to a filter plate in a filter press is provided. The connector comprises a collar portion configured to couple to the perimeter of a central opening on the filter cloth and a tab portion extending at an angle relative to the collar portion configured to engage a recess
5 in the filter plate.

According to another aspect of the invention, a method of assembling a filter plate is provided. The method comprises attaching a first filter cloth comprising a filter media and a central opening to a connector ring. The connector ring comprises a collar
10 portion and a tab portion extending perpendicular to the collar portion. The first filter cloth is connected to the connector ring at the collar portion. The method also comprises the step of engaging the tab portion of the connector ring with a recess in the filter plate. The filter plate includes a feed port for providing a slurry to be filtered.

15 According to another aspect of the invention a filter plate comprising a frame having a feed port and a first annular bore, a first filter cloth secured to a first side of the frame and a first flanged connector ring for securing the first filter cloth to the frame is provided. The first annular bore is configured to receive a portion of the first flanged
connector ring to secure the first filter cloth to the frame.

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According to yet another aspect of the invention a filter plate for supporting a filter cloth is provided. The filter plate comprises a frame and a feed port formed in the frame having an inner surface configured to receive a flanged connector ring for securing
a filter cloth to the frame at the central feed port.

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According to still another aspect of the invention a filter plate comprising a frame for supporting a filter cloth, a feed port formed in the frame and an undercut bore in the frame is provided. The undercut bore extends in a radial direction for receiving a flange
of a connector ring to secure a filter cloth to the filter plate.

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In another aspect of the invention, filter cloth is provided. The filter cloth comprises a liquid permeable filtering media for separating solids from the liquids in a slurry and a connector ring. The filtering media has a feed hole formed therein for allowing passage of the slurry through the filter cloth. The connector ring is attached to
5 an edge of the feed hole for connecting the filtering media to a filter plate.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects, features and advantages of the invention will be apparent from the following description and from the accompanying drawings, in which
10 like reference characters refer to the same parts throughout the different views. The drawings illustrate principles of the invention and, although not to scale, show relative dimensions.

FIG. 1 illustrates a filter press suitable for implementing an illustrative embodiment of the invention.

15 FIG. 2 is a cross sectional view of a filter plate stack of the filter press of Figure 1.

FIG. 3 shows a filter plate in the filter press of FIG. 1, in accordance with an illustrative embodiment of the present invention.

FIG. 4 is a cross sectional view of a central portion of an assembled filter plate
20 according to an illustrative embodiment of the invention.

FIG. 5 is a top view of the portion of the filter plate shown in FIG. 4.

FIG. 6 is an exploded cross-sectional view of the portion of the filter plate of
FIG. 4.

FIG. 7 is a detailed cross-sectional view of the cloth seal connector ring of FIG.
25 4.

FIG. 8 is a cross sectional view of a central portion of an assembled filter plate according to another embodiment of the invention.

FIG. 9 is a top view of the portion of the filter plate shown in FIG. 8.

FIG. 10 is an exploded cross-sectional view of the portion of the filter plate of
30 FIG. 8.

FIG. 11 is a cross-sectional view of a central portion of an assembled filter plate stack according to another embodiment of the invention, including a plurality of distribution rings.

5 DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

In the illustrative embodiments, the present invention provides an improved system and method for attaching one or more filter cloths to a filter plate in a filter press. The illustrative system includes a cloth connector ring, which connects a filter cloth with a filter plate. The cloth connector ring facilitates assembly of a filter plate, is designed
10 for manufacturability, is low in cost and provides improved efficiency and productivity of a filter press implementing the cloth connector ring to attach a filter cloth to a filter plate. The present invention will be described below relative to illustrative embodiments. Those skilled in the art will appreciate that the present invention may be implemented in a number of different applications and embodiments and is not
15 specifically limited in its application to the particular embodiments depicted herein.

Figure 1 illustrates a filter press 10 suitable for implementing an illustrative embodiment of the invention. The illustrative filter press 10 is a batch filtering machine comprising plurality of filter plates 20 clamped together and sealed against each other on
20 the wedge sides to form a filter plate stack 12. The filter plates form filter chambers 23 between each other. The filter plates support and are covered by filter cloths to form multiple cavities between the plates for collecting solids. The filter press 10 includes a feed head 18 at a first end of the machine containing piping for delivering a slurry to be filtered. As used herein, "slurry" refers to a mixture of liquid and solids that is
25 introduced to a filter press for separation. At a second end of the filter press 10 is a crosshead 14 containing a clamping mechanism. A moving plate 16, known in the art as a "tail plate", clamps the filter plate pack. During a filtering operation, slurry is pumped into filter chambers formed by the stacked filter plates and filter cloths, and is pushed against a filter cloth on a proximate filter plate. Liquid (filtrate) from the slurry passes
30 through the filter cloth and exits through filtrate ports in a filter plate. Solids from the slurry collect on the surface of the filter cloth within the chamber until the chamber is

full, which forms a filter cake. The filter cake may be washed or blown dry, if necessary. The collected filter cakes are discharged, completing the filtration cycle.

FIG. 2 is a cross-sectional view of a filter plate stack 12 of the filter press of FIG. 1, which comprises a plurality of filter plates 20 stacked together. An embodiment of an individual filter plate 20 is shown in FIG. 3. As shown, each filter plate 20 may comprise a frame 23 with a first layer or sheet of filtering cloth 22 and a second layer or sheet of filtering cloth 24 sealably joined to opposite sides of the frame 23. The filtering cloths 22, 24 form cavities or chambers 21 between the filter plates 20 for retaining solids between the filtering cloths 22, 24 when two or more filter plates 20 are stacked together. A slurry feed port 40 is formed in the center of the filter plate 20 for delivering a slurry to be filtered. Filtrate ports 25 may be provided at the edges of the frame 23 for receiving and transferring filtrate from the filter plate 20. In the illustrative embodiment, stay busses 26, or other suitable stabilization devices, may be provided around the central feed port 40 to help stabilize the filtrate plate 20. One skilled in the art will recognize that the invention is not limited to the illustrated filter plate stack or filter plate configuration, and that the filter plate stack and filter plate may have any suitable configuration for filtering a slurry.

The filter cloths 22 and 24 may be fabricated from a natural or man-made material or any combination thereof, which is acceptable for filtering applications. Suitable fabrics for forming the filter cloths 22, 24 include, but are not limited to natural fibers, such as cotton, or plastic fibers, such as polypropylene or nylon, for retaining cake solids. One skilled in the art will recognize that any suitable material for filtering a slurry may be used.

During a filtering process, a filter cloth 22 or 24 covers each side of the filter plate 20. As the slurry is pumped into the plate stack 12, the filter cloths retain the solids and allow the filtrate to pass through, completing the separation process. The filter cloths 22, 24 are fastened together and attached at an outside edge 27 formed in the perimeter of the plate 20. Any suitable means known in the art may be used to form the peripheral seal, including, but not limited to Velcro, ties, o-rings, a rope hammered into a

groove extending along the perimeter, and so on. The filter cloths 22, 24 are sealingly connected to each side of the filter plate 20 at the feed position 40, which receives a pumped slurry under pressure to fill the filter chamber 21.

5 According to an illustrative embodiment of the invention, each filter cloths 22 or 24 is connected to a side of a filter plate using a cloth connector ring. According to the illustrative embodiment, the filter plate includes a surface having a recess or other feature configured to receive and retain a cloth connector ring for attaching a filter cloth to the filter plate. For example, as described with respect to FIGS. 4-11, a flanged
10 connector ring 42, 44, 92, 94, 212 or 214 may be used to sealingly connect a filter cloth to a filter plate at a feed position 40 of the filter plate. According to the illustrative embodiment, the feed position 40 is located in the center of the plate. One skilled in the art will recognize that the feed position, and thus the attachment point of the filter cloths 22, 24 may alternatively be located in a corner or location offset from the center of the
15 filter plate 20.

FIG. 4 is a cross sectional side view of an assembled filter plate 20 at the point of attachment of the filter cloths 22, 24 according to an illustrative embodiment of the invention. FIG. 5 is a detailed top view of the region of the filter plate 20 where a filter
20 cloth 22 is attached to the filter plate. FIG. 6 is an exploded cross-sectional view of the components of the filter plate shown in FIG. 4. In the illustrative embodiment, each filter cloth 22, 24 includes a feed hole 52, 54, respectively, corresponding to the slurry feed port 40 of the filter plate. In the illustrative embodiment, a feed hole is located in the central portion of the filter cloth, though one skilled in the art will recognize that the
25 feed hole and feed ports may be located in any suitable position. A first cloth connector ring 42 is connected to the first filter cloth 22 around the perimeter of the feed hole 52 for attaching to first filter cloth 22 to a first side of the filter plate 20. A second cloth connector ring 44 is connected to the second filter cloth 24 around the perimeter of the feed hole 54 for attaching the second filter cloth 24 to a second side of the filter plate 20.
30 According to the illustrative embodiment, the cloth connector rings 42, 44 may be connected to the corresponding filter cloth by sewing, welding or mechanically coupling an inner edge of the filter cloth, defined by the central hole 52 or 54, to the

corresponding connector ring 42 or 44 through means known in the art. One skilled in the art will recognize that any suitable means for connecting a connector ring to a filter cloth may be used in accordance with the teachings of the invention.

5 According to an illustrative embodiment, as shown in FIGS. 4-7, the slurry feed port 40 of the filter plate 20 is configured to receive and retain a cloth connector ring 42 or 44. As shown, a filter cloth 22 or 24 may be attached to a side of the filter plate 20 by inserting an associated cloth connector ring 42 or 44 in the feed port 40, such that the inner surface of the feed port 40 receives and retains the cloth connector ring, thereby
10 attaching a filter cloth associated with the cloth connector ring to the filter plate. According to the illustrative embodiment, the cloth connector rings are configured to be received and retained by the inner surface of the central slurry feed port. For example, the cloth connector rings may have an outer surface that is complementary to the inner surface of the central slurry feed port. One skilled in the art will recognize that the filter
15 plate 20 and the cloth connector rings may have any suitable configuration for coupling the cloth connector ring to the filter plate, and that the invention is not limited to the illustrated configuration.

 In the embodiment shown in FIG. 4 and 6, the slurry feed port 40 of the
20 illustrative filter plate 20 includes recesses or grooves, illustrated as first and second undercut counter bores 46, 47 or slots cut into the filter plate on the inner surface of the port 40. In the illustrative embodiment, the bores 46, 47 extend in a radial direction, perpendicular to the longitudinal axis -A- of the filter plate 20. The first undercut counter bore 46 receives the first cloth connector ring 42 attached to the first filter cloth
25 22 and the second undercut counter bore 47 receives the second cloth connector ring 44 attached to the second filter cloth 24. The inner surface of the central feed port 40 also includes a first inclined surface 466 extending from the first side of the filter plate inward to the first bore 46 at an incline relative to the longitudinal axis -A- and a second inclined surface 467 extending from the second side of the filter plate 20 inward toward
30 the second bore 47. One skilled in the art will recognize that the surfaces 466 and 467 may alternatively extend parallel to the axis -A-. An annular central protrusion 468 extends around the inner surface of the feed port 40 between the bores 46, 47. The

annular central protrusion 468 is defined by walls 46c and 47c of the bores 46 and 47, respectively, and an axially extending surface 468a having a reduced diameter relative to the bores 46 and 47 and the surfaces 466 and 467.

5 Locking rings 62, 64 may also be provided for locking the cloth seal ring connector rings 42, 44, respectively in place after insertion, thereby locking the filter cloths 22, 24 to the filter plate 20.

FIG. 7 illustrates an embodiment of a cloth connector ring 42 in detail, though
10 one skilled in the art will recognize that the cloth connector ring 42 may have any suitable configuration for coupling to the filter plate 20 to attach a filter cloth to thereto. As shown in FIG. 7, the illustrative cloth connector ring has a configuration that is complementary in shape to the feed port inner surface, comprised of surfaces 466, 467, 468a and bores 46 and 47. As shown, the cloth connector ring 42 comprise a flat,
15 preferably annular, collar portion 421 attaching the cloth connector ring to a filter cloth. The collar portion 421 is configured to abut a first side of the filter plate in the vicinity of the feed port 40, as shown in FIG. 4.

The cloth connector ring 42 further includes a flanged tab clip portion 422
20 extending inward and substantially perpendicular to the collar portion 421. The flanged tab portion 422 is configured to abut the inner surface of the central feed port 40 to secure the cloth seal connector ring 42, and thus a connected filter cloth, to the filter plate. The tab portion 421 terminates in an axially outward extending tab clip 424, which is received by the bore 46 of the filter plate to secure the connector ring 42 to the filter
25 plate. The illustrative tab clip flange 424 includes a first surface 424a configured to abut a radially extending wall 46a of the bore and a second surface 424b configured to abut a longitudinally extending wall 46b of the bore. A third wall 424c and a fourth wall 424d of the flange 424 extend at inclines relative to the longitudinal axis and converge at an end, illustrated as a point 424e forming the end of the connector ring 42. The point 424e
30 abuts a second axially extending wall 46c, which terminates in the protrusion 468. Alternatively, the third wall 424c and fourth wall 424d may form a flat end configured to abut, and lie flat against, the central protrusion 468. One skilled in the art will recognize

that the tab portion 422 may have any suitable configuration for cooperating with a surface of the filter plate to attach the connector ring to the filter plate.

The illustrative tab portion 422 may further include serrations 423 on an inner
5 face 425 of the tab portion 422, opposite the surfaces that interact with the feed port inner surface. The serrations 423 enhance the friction fit between the connector ring and a corresponding locking ring 62 or a distribution ring (described below). As shown, the tab portion outer surface 426 matches the inclined surface 466 of the slurry feed port 40 of the filter plate and is configured to abut against the inclined surface 466. As shown,
10 the tab portion outer surface 426 is inclined relative to the longitudinal axis at a similar angle to the angle of the inclined surface 466. The tab portion outer surface 426 abuts the inclined surface 466 of the slurry feed port 40 when the filter plate is assembled to securely and sealingly connect the filter cloth 22 to the filter plate 20. One skilled in the art will recognize that the tab portion outer surface 426 and the inner surface 466 of the
15 slurry feed port may have any suitable configuration. According to a preferred embodiment, the tab portion outer surface 426 and the inner surface 466 of the slurry feed port have complementary shapes to facilitate attachment of the cloth connector ring to the filter plate.

20 According to the illustrative embodiment, the second cloth connector ring 44 of FIGS. 4-6 is configured similar to the first cloth connector ring 42, though one skilled in the art will recognize that the cloth connector rings 42 and 44 may have different configurations. One skilled in the art will recognize that the tab portions and cloth connector rings are not limited to the illustrative configuration and that any suitable
25 configuration for sealingly connecting the filter cloth to the filter plate may be used in accordance with the invention.

The cloth connector ring 42, 44 may be manufactured from rubber, thermoplastic rubber, plastic, cloth or any other suitable material and may be formed by machining,
30 molding or any other suitable process.

To assemble the filter plate 20 of FIGS. 4-6 using a cloth connector ring having a configuration shown in FIG. 7, a first filter cloth 22 is connected to a first cloth connector ring 42 and aligned with the filter plate, such that the feed port 52 of the filter cloth 22 aligns with the feed port 40 of the filter plate 20. The tab portion 422 of the connector ring is pushed into the feed port 40, such that the flange 424 engages the bore 46 and the inclined outer surface 426 abuts the inclined inner surface 466 of the filter plate. Next, the locking ring 62 is pushed into position in the central feed port 40 to lock the tab clip flange 424 into the bore 46 on the filter plate body. The locking ring is pushed until the end of the locking ring abuts the protrusion 468 and the outer surface of the locking ring abuts the inner surface of the tab portion. The locking ring 62 is stopped by the protrusion ring 468 and held in place by friction fit with the serrations 423 and the protrusion ring 468. The outer edges of the filter cloth are then attached to the outer edges of the filter plate frame through means known in the art, as described above. The second filter cloth 24 is attached to the second side of the filter plate 20 in a similar manner, using the second cloth connector ring 44 and second locking ring 64.

According to another embodiment of the invention, the recesses receiving the connector rings for attaching a filter cloth to a filter plate comprise slots. For example, as shown in FIGS. 8-10, a filter plate 70 includes a first slot 86 for attaching a first filter cloth 72 to a first side of the filter plate 70 using a first cloth connector ring 92 and a second slot 88 for attaching a second filter cloth 72 to a second side of the filter plate 70 using a second cloth connector ring 94. As shown, in the second embodiment, the central feed port 90 has a straight inner surface 91. The first slot 86, which preferably comprises an annular undercut groove, is spaced axially outwardly from and surrounding the central feed port 90 and is cut into the first side of the filter plate for receiving the first connector ring 92 and first lock ring 96 in order to fasten the first filter cloth 72 to the filter plate 70. A second slot 88, preferably an annular undercut groove aligned with the first circular undercut slot and spaced axially outwardly from and surrounding the central feed port 90, is cut into the second side of the filter plate for receiving the second connector ring 94 and second lock ring 98 in order to fasten the second filter cloth 74 to the filter plate 70.

According to the illustrative embodiment, the filter cloths 72, 74 and connector rings 92, 94 of FIGS. 8-10 are substantially identical to the filter cloths 22, 24 and connector rings 42, 44 of FIGS. 4-7. However, in the embodiment of FIGS. 8-10, the diameters of the feed holes 82, 84 of the filter cloths and connector rings is larger than the diameter of the central feed port 90, rather than the same as the diameter of the central feed hole, as shown in the embodiment of FIGS. 4-7. In the embodiment of FIGS 8-10, the diameter of the connector rings and filter cloths are configured to allow insertion of the tab portions 922, 942 of the connector rings 92, 94 in the slots 86, 88 of the filter plate.

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As shown, each slot 86, 88 is spaced from the feed port 90 and includes a main portion 861, 881, respectively, extending substantially parallel to the longitudinal axis. The main portions 861, 881 have an inclined wall 861a, 881a, respectively, configured to abut the inclined wall 866, 868 of the corresponding tab portion 922, 942, respectively and a longitudinally extending wall 861b, 881b. Each slot further includes a radially extending recess 926, 928, respectively for receiving the flange 924, 925 of the tab portion on the connector ring.

To assemble the filter plate 70 of FIGS. 8-10, the first filter cloth 72 is connected to the associated cloth connector ring 92 and aligned with the filter plate such that the feed port of the filter cloth aligns with the feed port of the filter plate. The tab portion 922 of the connector ring is pushed into the circular slot 86, such that the flange 924 engages the radially extending recess 926 and the inclined inner surface 866 abuts the inclined inner surface 861a of the filter plate. Next, the locking ring 62 is inserted into the slot 86 between the tab portion 922 and the longitudinally extending wall 861b and pushed into position to lock the tab clip flange 924 into the bore 46 on the filter plate body. The locking ring 96 is pushed until the end of the locking ring abuts the radially extending wall of the recess 926. The serrations on the surface of the connector ring hold the locking ring in place by friction fit. The second filter cloth 74 is attached to the second side of the filter plate 70 in a similar manner, using the second cloth connector ring 94 and second locking ring 98.

According to yet another embodiment of the invention, shown in FIG. 11, a filter plate pack 100 includes one or more distribution rings 110 in place of the lock ring to secure the cloth connector rings and filter cloths to the filter plate frame. Distribution rings are known in the art and are used in filter presses to support the filter plate at the feed port to prevent overflexing the plate during the feed cycle, caused by pressure differentials. The distribution rings 110 ensure that the plates are stacked evenly to enhance the filtering process. Each distribution ring contacts a distribution ring on an adjoining plate to form a continuous support along the length of a filter plate pack. Slurry enters a filter chamber 120 between the filter plates via peripheral slots formed or machined into the circumference of the distribution rings faces.

As shown in FIG. 11, each filter plate 200 has a pair of filter cloths 202, 204 attached to either side of the filter plate via connector rings 212, 214. The connector rings are attached to the filter cloths at the central opening of each feed cloth, though one skilled in the art will recognize that the connector rings may be attached to any suitable location on the filter plate using any suitable connection means. In the illustrative embodiment, the connector rings 212, 214 engage counter bores 146, 147 in the inner surface of the central feed port 190 of the filter plate, as described above with respect to the embodiments shown in FIGS. 4-7, though one skilled in the art will recognize that the invention is not limited to the illustrated embodiment. A distribution ring 110 is pushed into position and held by a press fit and friction of the tab serrations on the tab portion of the connector rings 212, 214. By the action of clamping the filter press, the distribution rings 110 are correctly seated without contacting the bottom of the counter bores 146, 147 of the filter plate. When the filter is clamped, a positive seal is created between the distribution ring and the cloth connector ring. The filter plate 200 of FIG. 11 is substantially identical to filter plate of FIGS. 4-7, however, the counter bores 146, 147 of the plate 200 may be wider than the bores 46, 47 of the plate 20 to prevent the distribution rings 110 from contacting the wall of the protrusion 1468 in filter plate 200.

In addition to facilitating installation of the filter cloths 202, 204 on a filter plate 200, the embodiment of FIG. 11 facilitates installation of the distribution rings 110 in the filter stack 100. Prior distribution rings are generally awkward to install and are required

to be screwed together. The present invention allows manual installing without difficulty. The distribution rings can be inserted into the feed ports by hand and are held in place by friction fit.

5 The illustrative systems and methods for attaching filter cloths to a filter plate using a flanged cloth connector ring provides significant advantages over the prior art. The present invention allows a pair of filter cloths to be individually and independently installed on opposite side of a filter without requiring the filter cloths to be attached to each other. In this manner, one filter cloth can be removed and replaced without having
10 to remove and replace the associated filter cloth, resulting in significant cost savings. The illustrative system is simple to manufacture and provides easy and fast installation of a filter cloth on a filter plate. Furthermore, the illustrative filter plate assembly allows for a central feed design, which has enhanced feed delivery over a corner feed design.

15 It is thus seen that the invention efficiently attains the objects set forth above, among those made apparent from the preceding description. Since certain changes may be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings be interpreted as illustrative and not in a limiting sense.

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It is also to be understood that the following claims are to cover all generic and specific features of the invention described herein, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

25 Having described the invention, what is claimed as new and desired to be secured by Letters Patent is:

We claim:

1. A connector for attaching a filter cloth to a filter plate in a filter press,
5 comprising:
a collar portion configured to couple to the perimeter of a central opening on the filter cloth; and
a tab portion extending at an angle relative to the collar portion configured to engage a recess in the filter plate.
- 10 2. The connector of claim 1, further comprising serrations on an inner surface of the tab portion.
3. The connector of claim 1, further comprising a lock ring for securing the tab
15 portion in the recess.
4. The connector of claim 1, wherein the tab portion extends substantially perpendicular to the collar portion.
- 20 5. The connector of claim 1, wherein the collar portion and tab portion are formed of a material selected from the group consisting of rubber, thermoplastic rubber, plastic and mixtures thereof.
6. The connector of claim 1, wherein the collar portion forms an annular ring
25 having a hole corresponding to a hole of the filter cloth.
7. The connector of claim 1, wherein the tab portion includes an outer surface that is inclined relative to a longitudinal axis of the connector, wherein the outer surface is configured to abut an inclined surface of the filter plate.

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8. The connector of claim 1, wherein the collar portion has a substantially flat surface extending perpendicular to a longitudinal axis, which is configured to abut a first side of filter plate.
- 5 9. The connector of claim 1, further comprising a tab clip extending from the tab portion for engaging a bore of the filter plate.
10. The connector of claim 9, wherein the tab clip includes a first surface extending perpendicular to the tab portion, a second surface extending parallel to a longitudinal
10 axis of the connector and a third and fourth surface extending at an angle relative to the longitudinal axis, wherein the third and fourth surface intersect at to form a point at an end of the connector.
11. A method of assembling a filter plate, comprising
15 attaching a first filter cloth comprising a filter media and a central opening to a connector ring comprising a collar portion and a tab portion extending perpendicular to the collar portion, wherein the first filter cloth is connected to the connector ring at the collar portion; and
engaging the tab portion of the connector ring with a recess in the filter plate,
20 wherein the filter plate includes a feed port for providing a slurry to be filtered.
12. The method of claim 11, further comprising the step of inserting a locking ring in the filter plate to secure the connector ring against the feed port.
- 25 13. The method of claim 11, wherein the annular recess is formed on an inner surface of the feed port.
14. The method of claim 11, wherein the annular recess spaced from the feed port.

15. The method of claim 11, further comprising the steps of:
attaching a second filter cloth comprising a filter media and a central opening to a second connector ring comprising a collar portion and a tab portion extending perpendicular to the collar portion; and
5 engaging the tab portion of the second connector ring with a second recess in the filter plate.
16. A filter plate comprising:
10 a frame having a feed port and a first annular bore;
a first filter cloth secured to a first side of the frame; and
a first flanged connector ring for securing the first filter cloth to the frame,
wherein the first annular bore is configured to receive a portion of the first flanged connector ring to secure the first filter cloth to the frame.
- 15 17. The filter plate of claim 16, further comprising a second filter cloth secured to a second side of the frame; and
a second flanged connector ring for securing the second filter cloth to the frame.
- 20 18. The filter plate of claim 16, wherein the first annular bore is located in an inner surface of the feed port for connecting the first filter cloth to the frame in the vicinity of the feed port.
19. The filter plate of claim 18, wherein the first annular bore is configured to
25 receive a projection of the connector ring.
20. The filter plate of claim 18, wherein the inner surface of the feed port further includes a surface extending at an angle relative to a longitudinal axis of the filter plate for abutting an inclined surface of the connector ring.
- 30 21. The filter plate of claim 20, wherein the inner surface of the feed port forms a protrusion ring of reduced diameter for stopping the connector ring.

22. The filter plate of claim 18, wherein inner surface of the feed port comprises a first inclined surface extending from a first side of the filter plate, the first annular bore located adjacent to the first inclined surface and an axially extending surface adjacent the first annular bore, wherein the axially extending surface defines a protrusion ring of reduced diameter relative to the first inclined surface and the annular bore.

23. The filter plate of claim 22, wherein the inner surface of the feed port further comprises a second inclined surface extending from a second side of the filter plate, and a second annular bore between the second inclined surface and the axially extending surface.

24. The filter plate of claim 16, further comprising a distribution ring inserted in the feed port for securing the connector ring in the feed port.

25. The filter plate of claim 16, further comprising a locking ring for securing a portion of the connector ring in the feed port.

26. The filter plate of claim 16, wherein the first annular bore is located in a slot spaced from the feed port.

27. The filter plate of claim 26, wherein the feed port has an inner surface comprising an axially extending flat surface.

28. The filter plate of claim 26, wherein the slot includes an inclined surface adjacent to the first annular bore and the connector ring includes an inclined surface configured to abut the inclined surface of the slot.

29. The filter plate of claim 16, wherein the filter cloth has a feed hole having a perimeter corresponding to the feed port of the frame.

30. The filter plate of claim 29, wherein the connector ring couples to the perimeter of the feed hole.

31. The filter plate of claim 30, wherein the connector ring has a diameter that is
5 greater than the diameter of the feed port.

32. The filter plate of claim 30, wherein the connector ring has a diameter that is smaller than the diameter of the feed port.

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33. A filter plate for supporting a filter cloth, comprising
a frame, and
a feed port formed in the frame having an inner surface configured to receive a
flanged connector ring for securing a filter cloth to the frame at the central feed port.

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34. The filter plate of claim 33, wherein the inner surface comprises a first inclined surface extending from a first side of the frame, a first annular bore adjacent to the first inclined surface, a second inclined surface extending from a second side of the frame, a second annular bore adjacent to the second inclined surface and a protrusion ring
20 between the first annular bore and the second annular bore.

35. A filter plate, comprising:
a frame for supporting a filter cloth;
a feed port formed in the frame,
25 an undercut bore formed in the frame and extending in a radial direction for receiving a flange of a connector ring to secure a filter cloth to the filter plate.

36. A filter cloth, comprising:
a liquid permeable filtering media for separating solids from the liquids in a
30 slurry, the filtering media having a feed hole formed therein for allowing passage of the slurry through the filter cloth; and

a connector ring attached to an edge of the feed hole for connecting the filtering media to a filter plate.

37. The filter cloth of claim 36, wherein the connector ring comprises:
- 5 a collar portion configured to couple to the edge of the feed hole; and
- a tab portion extending at an angle relative to the collar portion configured to engage a recess in the filter plate.

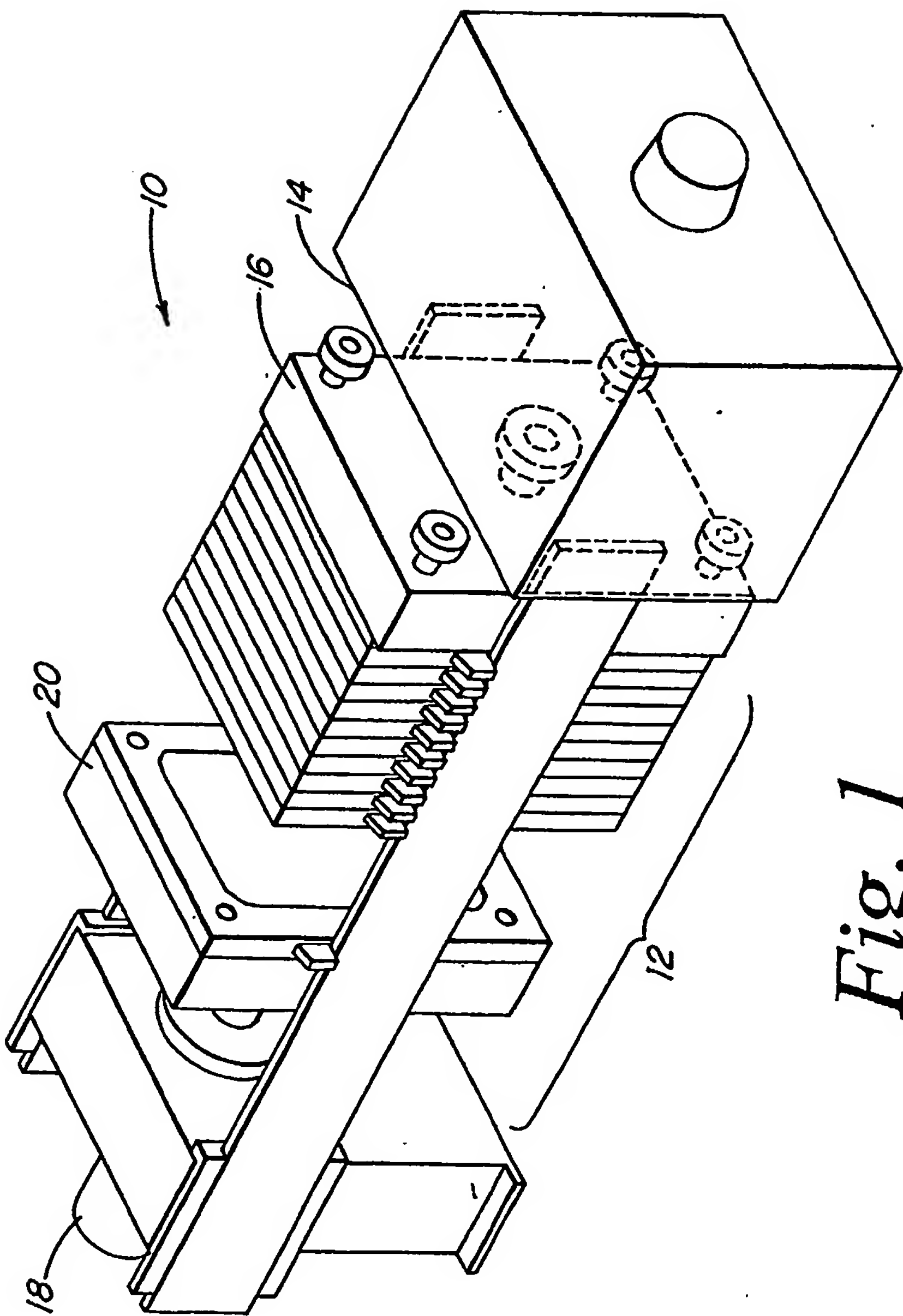


Fig. 1

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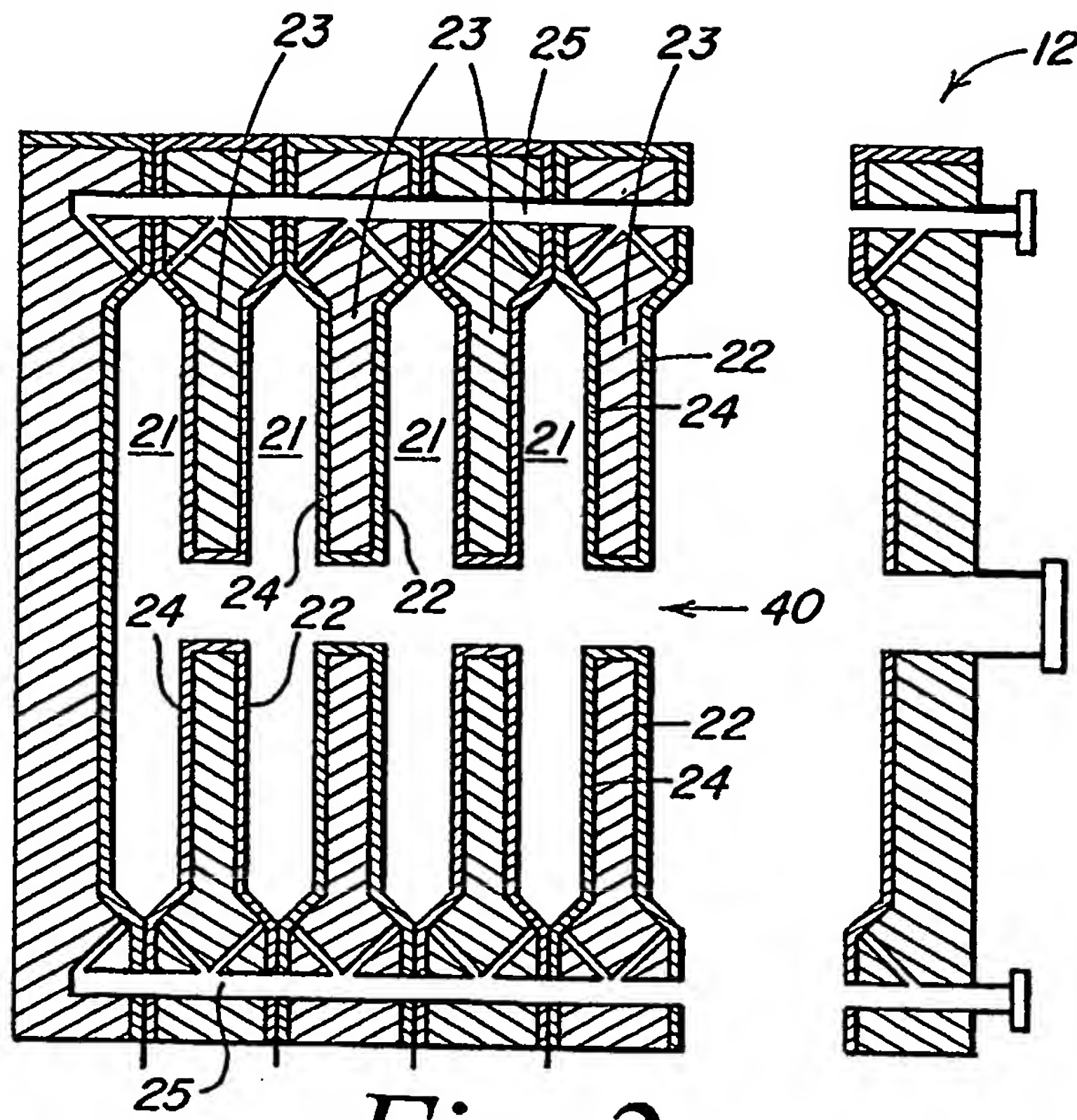


Fig. 2

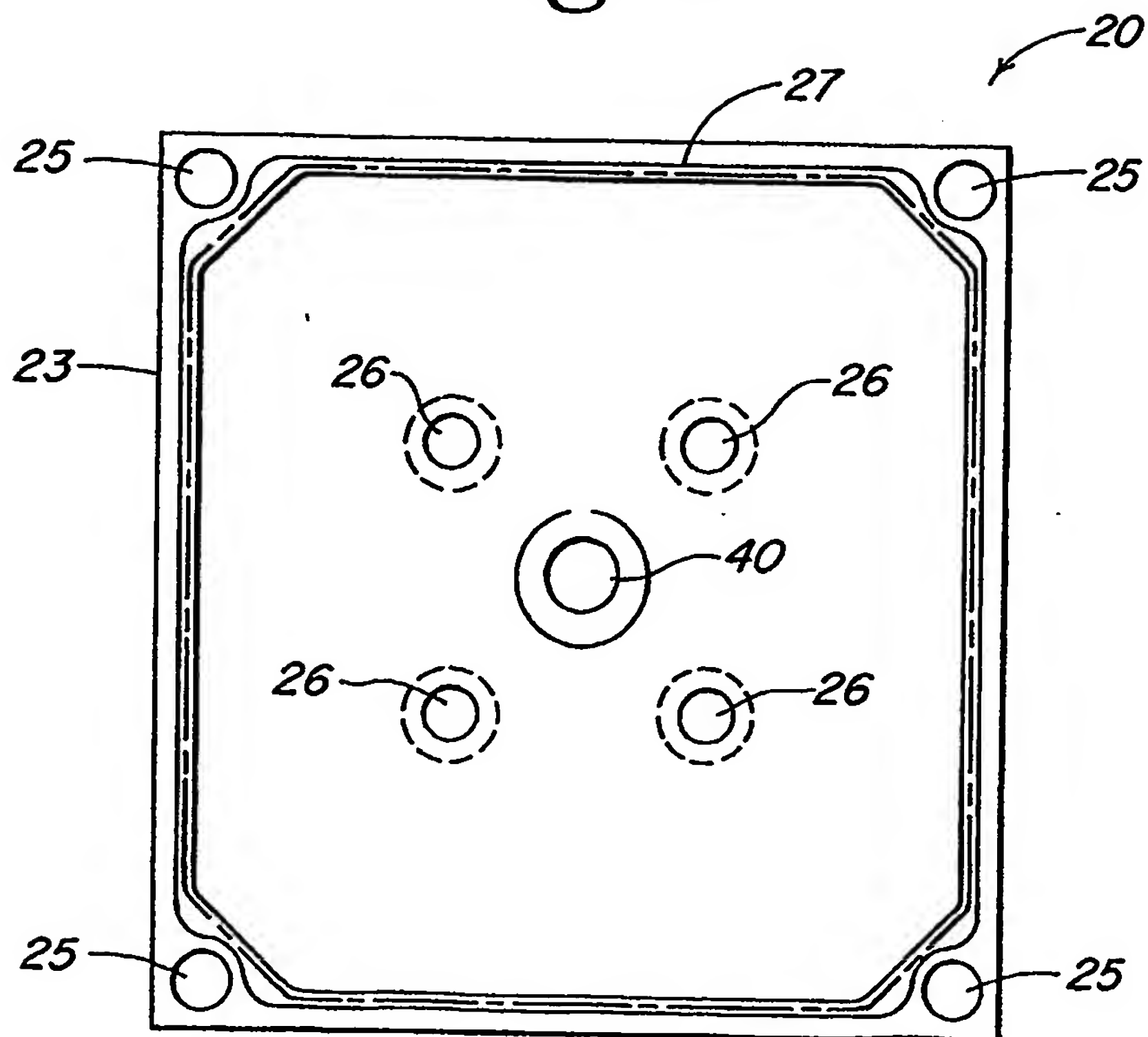


Fig. 3

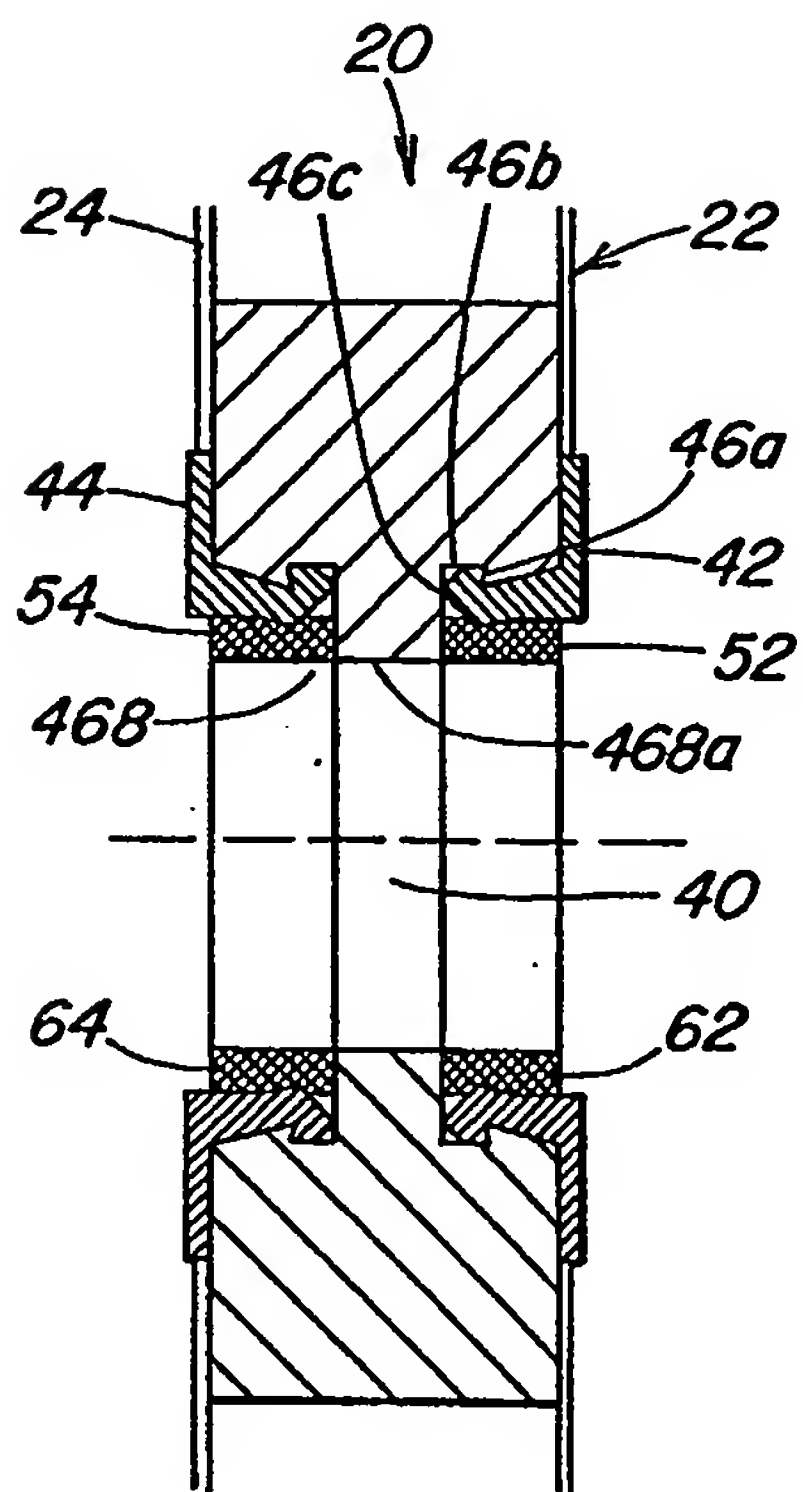


Fig. 4

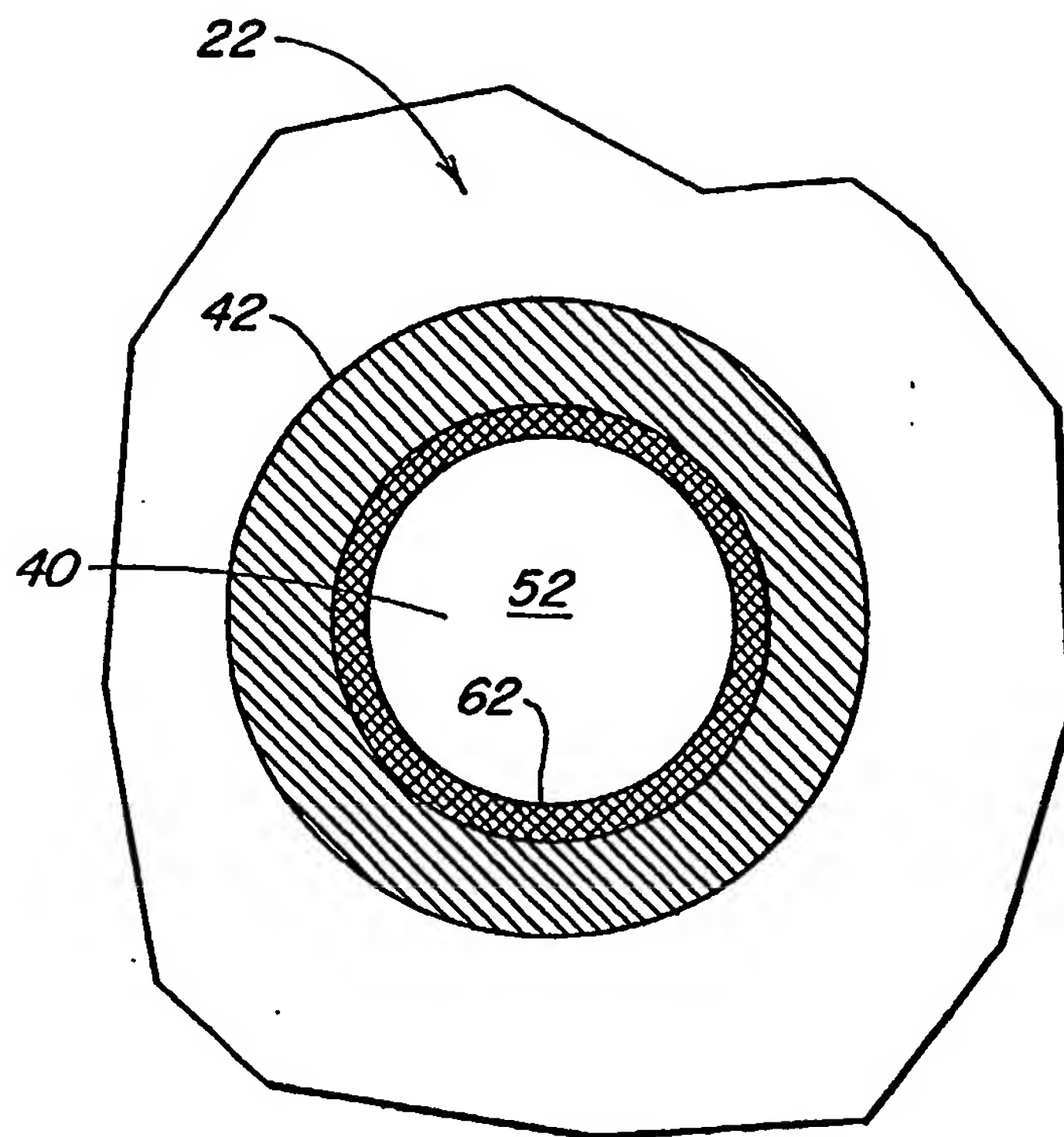


Fig. 5

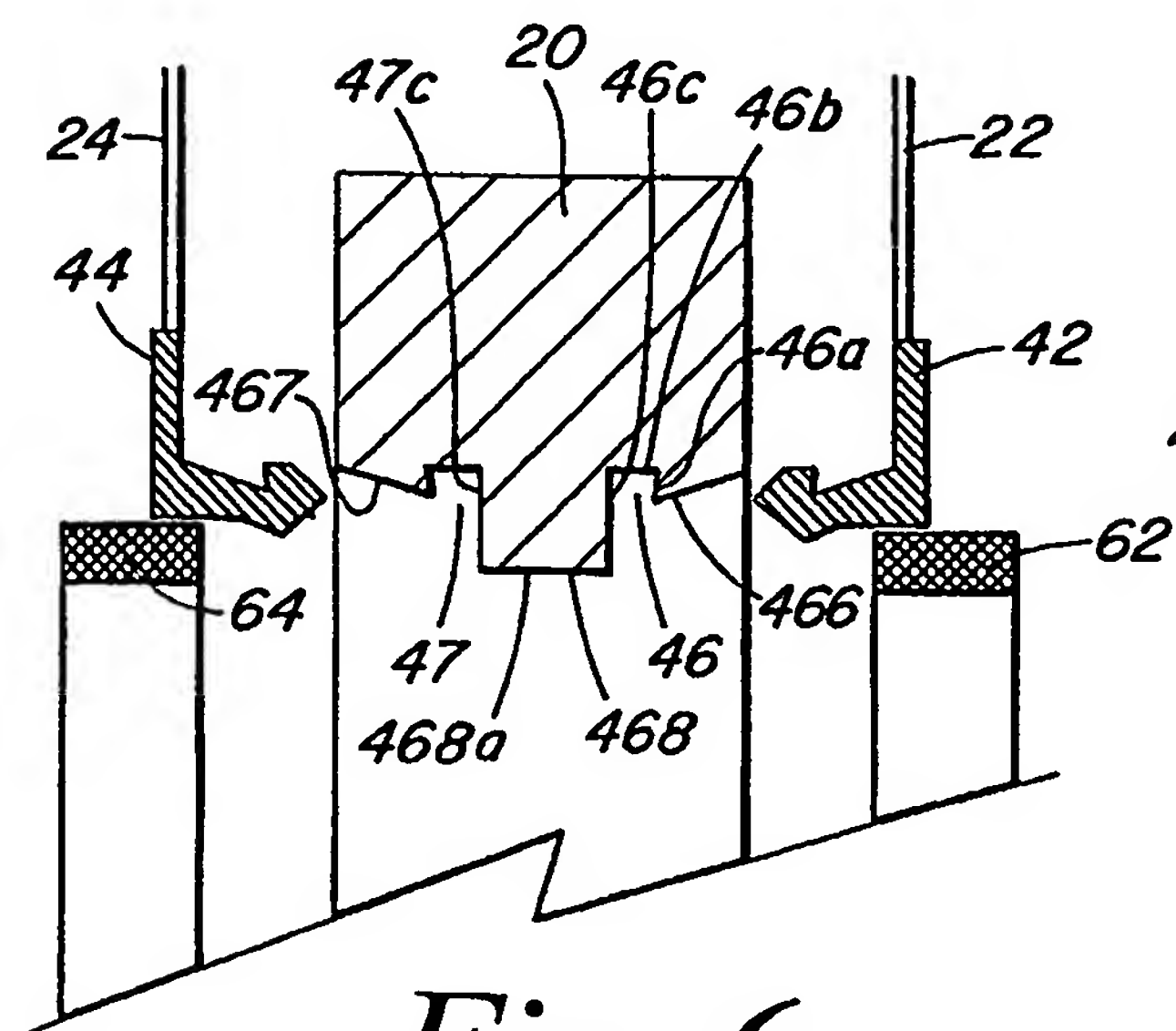


Fig. 6

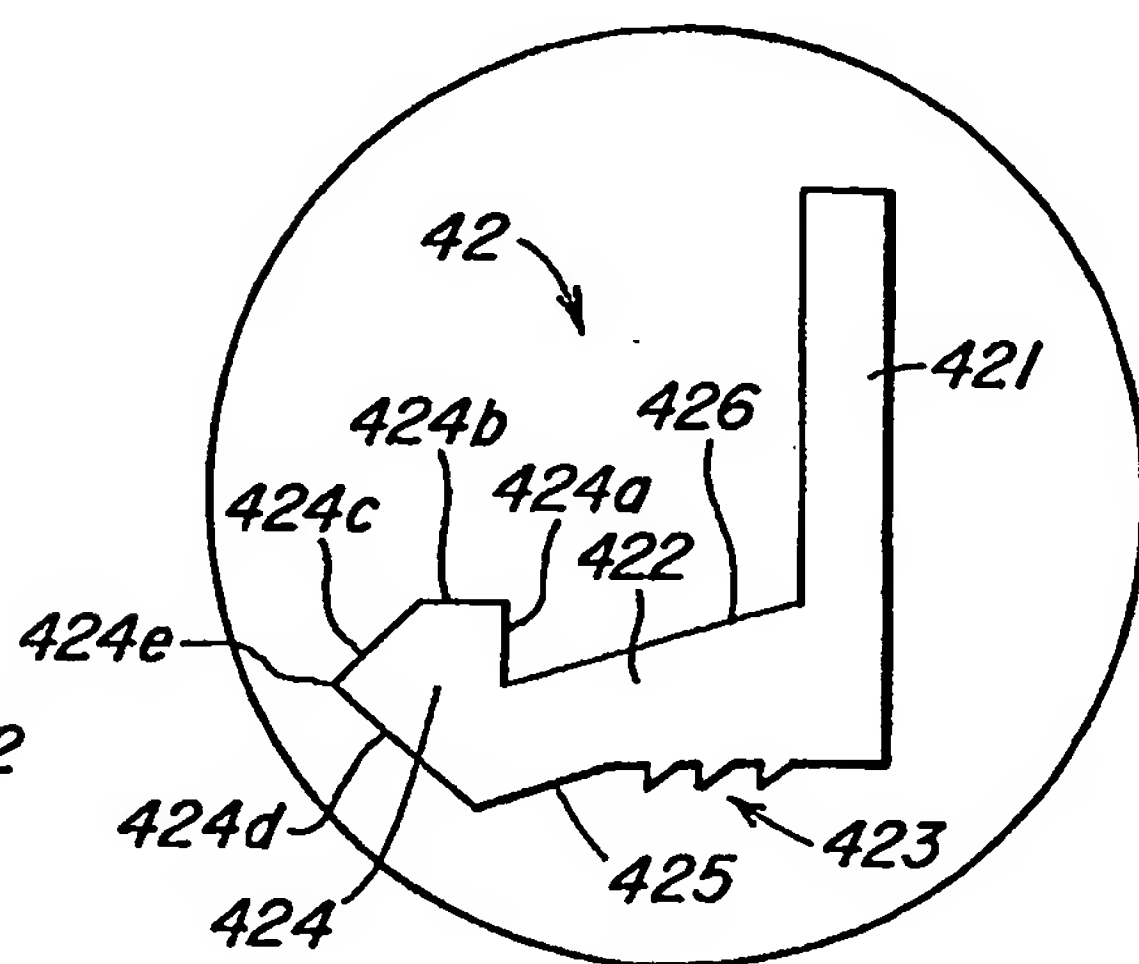


Fig. 7

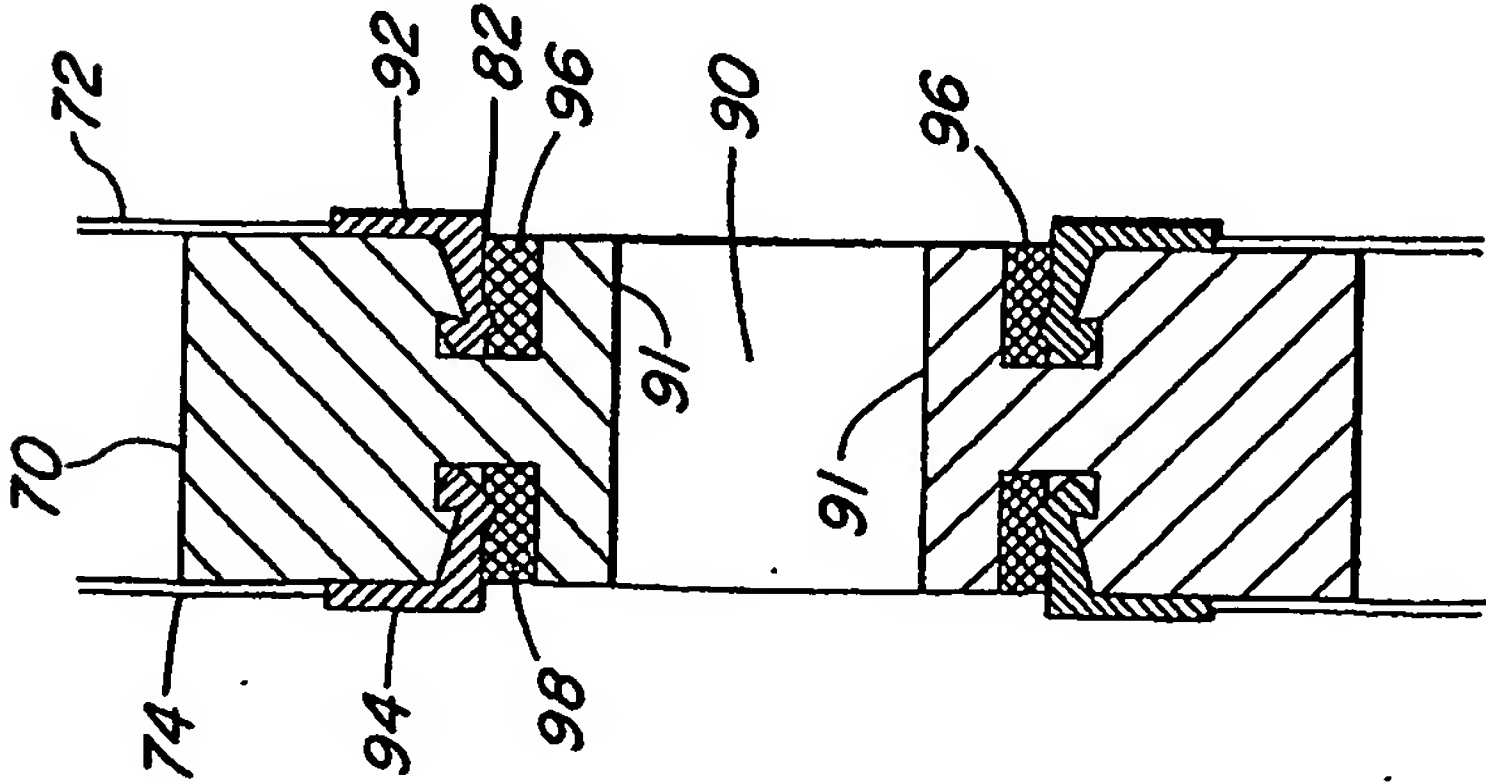


Fig. 8

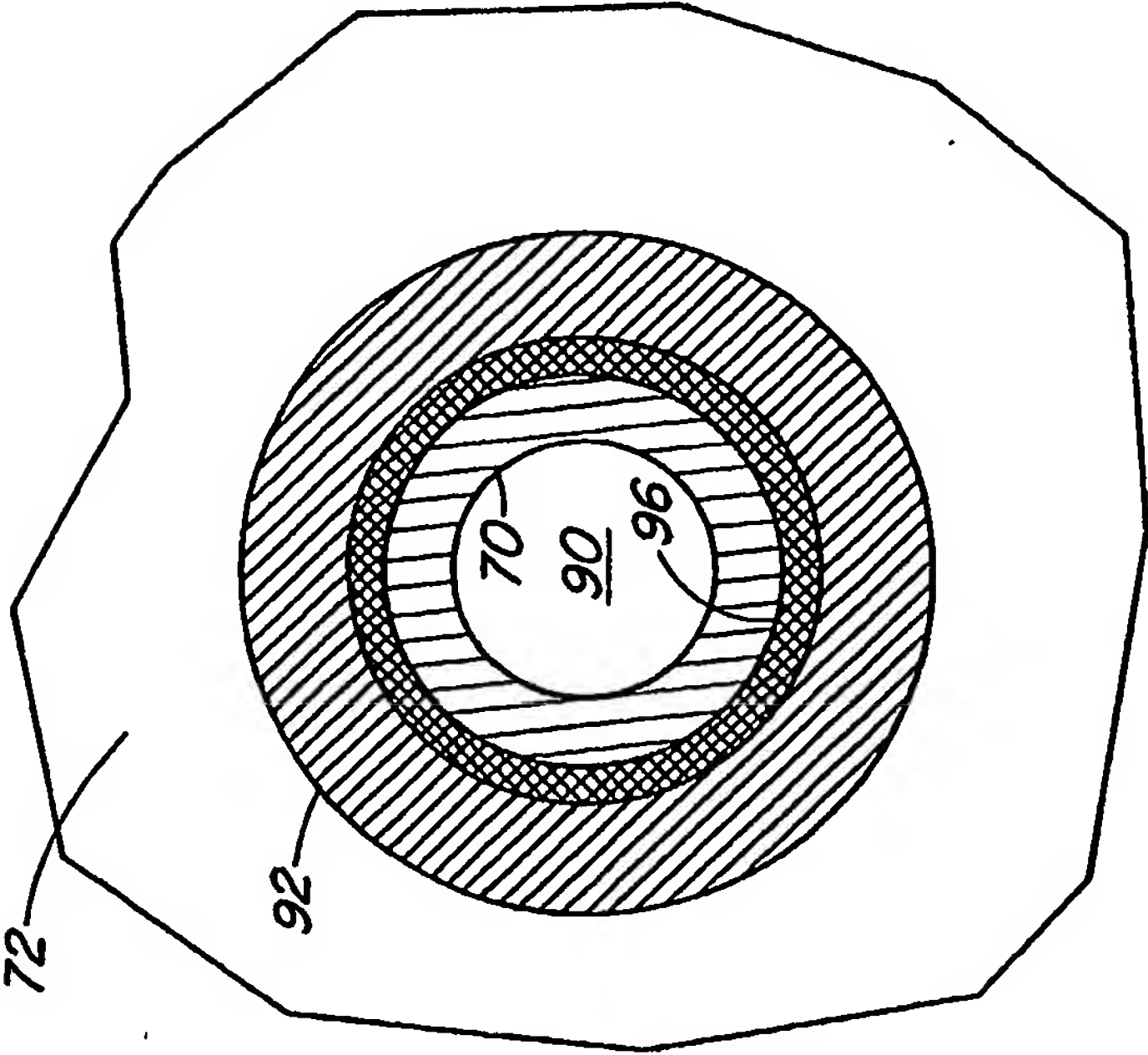


Fig. 9

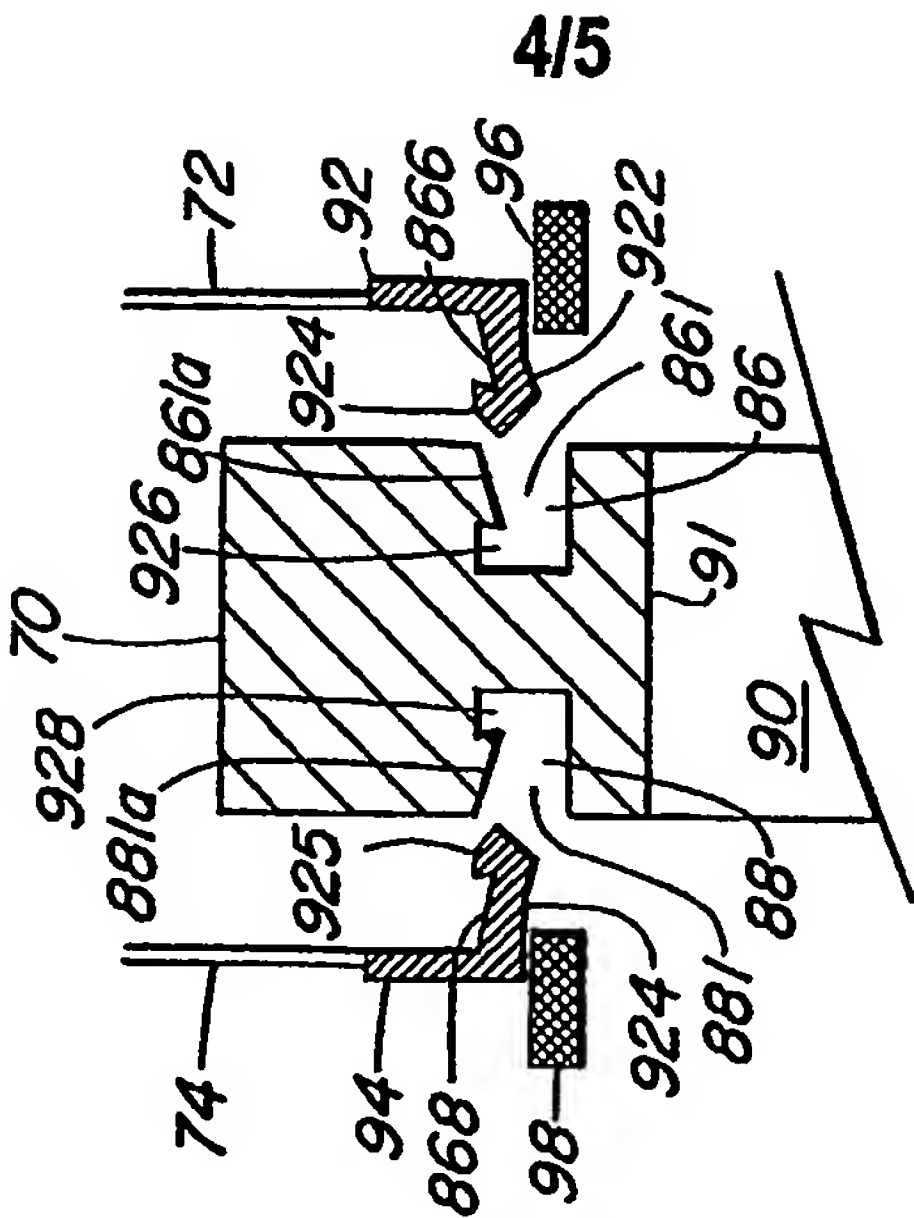


Fig. 10

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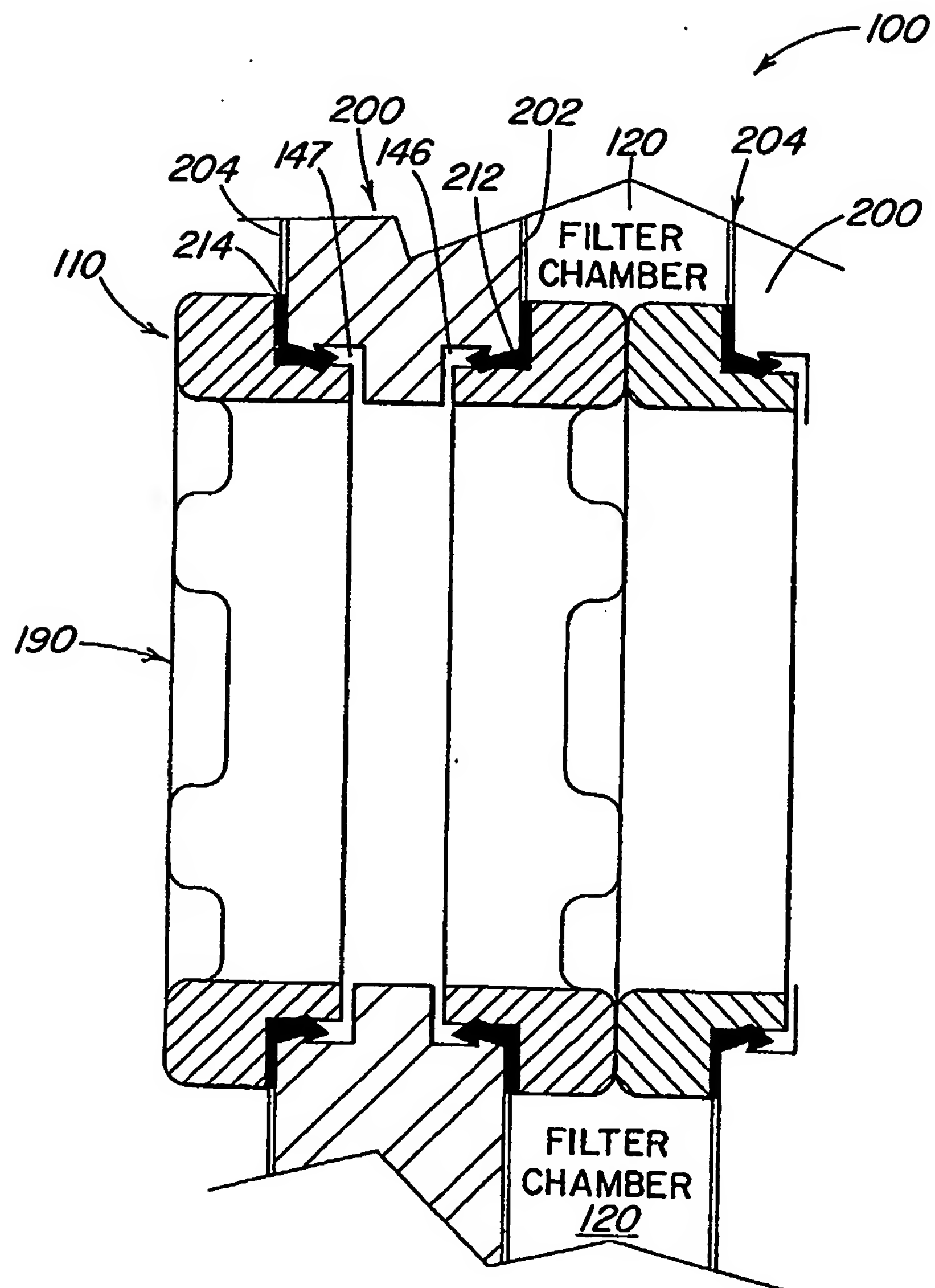


Fig. 11

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/31256

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : B01D 25/176
US CL : 210/230

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 210/227-231

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X — A	FR 1,593,016 A (TISSMETAL-LIONEL-DUPONT) 03 July 1970 (03.07.1970), page 1, lines 31-43).	1, 3-9, 11-37 2, 10

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

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12 January 2004 (12.01.2004)

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